

Experimental results for microfin tubes are compared with predictions of a recently proposed correlation scheme. Only data for the microfin tube with a geometry much similar to the one accounted for by the scheme yielded good correlation with the predictions.

98/03311 Heat transfer enhancement by fins during the heat storage stage in a latent heat storage system

Lee, M. K. and Han, G. Y. *et al.* *Hwahak Konghak*, 1997, 35, (5), 755-761. (In Korean)

This paper considers the heat transfer characteristics of a low temperature latent heat storage system during the heat storage stage for circular finned tubes using $\text{Na}_2\text{SO}_4 \cdot 10\text{H}_2\text{O}$ and paraffin wax as phase change materials. The heat storage vessel has the dimension of 530 mm height, 74 mm inside diameter and inner heat transfer tube is 480 mm in height and 13.5 mm outside diameter. The heat transfer fluid is hot water. Conduction was a major heat transfer mechanism for the $\text{Na}_2\text{SO}_4 \cdot 10\text{H}_2\text{O}$ during the heat storage stage, while both conduction and natural convection were the major heat transfer mechanism for the paraffin wax. The heat transfer enhancement by fins over the unfinned heat transfer tube was negligible with the thin finned tube system, whereas the enhancement by the thick finned tube was significant. The overall heat transfer coefficients for $\text{Na}_2\text{SO}_4 \cdot 10\text{H}_2\text{O}$ and paraffin wax were found to be in the range of 80-180 $\text{W/m}^2\text{K}$ and 50-180 $\text{W/m}^2\text{K}$ respectively.

98/03312 The impact of consumer behavior on residential energy demand for space heating

Haas, R. *et al.* *Energy and Buildings*, 1998, 27, (2), 195-205.

With respect to energy consumption in households, besides technical parameters, consumer behaviour is the most important issue. In this paper, the results of a cross-section analysis of Austrian households are presented. The impact of the following parameters on residential energy demand for space heating have been investigated: (i) thermal quality of buildings; (ii) consumer behaviour; (iii) heating degree days; (iv) building type (single- or multi-family dwellings). The result of this investigation provides evidence of a rebound-effect of about 15-30% due to building retrofit. This leads to the conclusion that energy savings achieved in practice (and straightforward the reduction in CO_2 emissions) due to energy conservation measures will be lower than those calculated in engineering conservation studies. Straightforward, the most important conclusions for energy policy makers are: (i) Standards, building codes, respectively, are important tools to increase the thermal quality of new buildings; and (ii) due to prevailing low energy prices, a triggering tool has to be implemented which may be rebates or loans.

98/03313 Numerical simulation of a multi-layer latent heat thermal energy storage system

Brousseau, P. and Lacroix, M. *Int. J. Energy Res.*, 1998, 22, (1), 1-15.

Presents a computational model, based on the conservation equations of energy for the phase change material (PCM) and the heat transfer fluid (HTF), predicts the thermal behaviour of a compact multi-layer latent heat storage unit. Embedded inside the PCM, electric heat sources are used for heat storage (melting) while the flow of an HTF is employed for heat recovery (solidification). Parametric studies are performed to assess the effect of various design parameters and operating conditions on the thermal behaviour of the unit. The average output heat load during the recovery period is strongly dependent on the minimum operating temperature, the thermal diffusivity of the liquid phase, the thickness of the PCM layer and the HTF inlet mass flowrate and temperature. On the other hand, it is nearly independent of the wall thermal diffusivity and thickness and of the maximum operating temperature. Correlations are proposed for the total energy stored and the output heat load as a function of the design parameters and the operating conditions.

98/03314 Optimal configuration of a class of two-heat-reservoir refrigeration cycles

Chen, L. *et al.* *Energy Convers. Mgmt.*, 1998, 39, (8), 767-773.

With a given cycle time and absorbed heat (cooling load) with consideration of heat leak, finite heat capacity low-temperature source and infinite heat capacity high-temperature heat sink, the optimal coefficient of performance (COP) of a class of two-heat-reservoir refrigeration cycles can be determined. It is assumed that the heat transfer between the working fluid and the reservoirs obeys Newton's law. The existence of the heat leak is shown not to affect the optimal configuration of a cycle with an infinite low-temperature source. The finite heat capacity of a low temperature source without heat leak makes the cycle a generalized Carnot refrigeration cycle. There exists a great difference of the cycle configurations for the finite low temperature source with heat leak and the former three cases. Moreover, the relationship between the optimal cooling load and the COP of the former three configurations are derived, and they show that the heat leak affects the cooling load versus COP characteristics of the refrigeration cycles.

98/03315 A parametric study of Trombe walls for passive cooling of buildings

Gan, G. *Energy and Buildings*, 1998, 27, (1), 37-43.

In a naturally-ventilated room, air movement can be induced through the use of a solar chimney or Trombe wall. This work studies Trombe walls for application in the cooling of buildings in the summer. Ventilation rates resulting from natural cooling were predicted using the CFD (computa-

tional fluid dynamics) technique. Buoyant air flow and flow rate in enclosures with Trombe wall geometries were predicted with the renormalization group (RNG) k- turbulence model. The CFD programme was validated against experimental data from the literature and very good agreement between the prediction and measurement was achieved. The predicted ventilation rate increased with the wall temperature and heat gain. The effects of the distance between the wall and glazing, wall height, glazing type and wall insulation were also investigated. In order to maximize the ventilation rate, the interior surface of a Trombe wall should be insulated for summer cooling, which would also prevent undesirable overheating of room air due to convection and radiation heat transfer from the wall.

98/03316 Performance and optimization criteria for forward and reverse quantum Stirling cycles

Wu, F. *et al.* *Energy Convers. Mgmt.*, 1998, 39, (8), 733-739.

This paper studies the optimal performance for forward and reverse quantum Stirling cycles. The finite time thermodynamic performance bound and optimization criteria for these cycles are derived. The optimal relations between the performance parameters for quantum Stirling engines, refrigerators and heat pumps are obtained.

98/03317 Performance of a second generation solar cooling unit

Hammad, M. and Zurigat, Y. *Solar Energy*, 1998, 62, (2), 79-84.

The performance of a 1.5 ton solar-operated absorption refrigeration unit, operating with a 14 m^2 flat-plate solar collector system and containing five heat exchangers, is described. This particular unit, called the second generation unit, is compared with an earlier, first-generation unit (FGU), i.e. a low-cost, locally manufactured unit of 0.5 ton capacity. The operation of the unit was observed during hours of sufficient solar irradiance in April and May, the beginning of the air-conditioning season in Jordan. The variation of both the generator and evaporator temperatures during the test period are reported. Also reported is the performance of the unit as measured by the actual and theoretical (ideal) coefficients of performance, both of these being functions of the temperatures and solar irradiance. For both actual and theoretical coefficients of performance, the maximum values obtained were 0.85 and 2.7, respectively. These values are within the range of values published in literature, and higher than those obtained by the FGU.

98/03318 Phase change cool storage using dimethylsulfoxide

Farid, M. M. *et al.* *Energy Convers. Mgmt.*, 1998, 39, (8), 809-818.

The paper investigates the feasibility of cool storage using dimethylsulfoxide as a phase change material (PCM) in a rectangular enclosure. Measurements were taken of the temperature distribution in the PCM and the inlet and outlet temperatures of the flowing air. The two-dimensional unsteady heat conduction equation was solved numerically to predict the temperature distribution in both phases of the PCM. The effect of the latent heat of melting was included by using an effective heat capacity that includes the latent heat. Good agreement was found between the model prediction and the experimentally measured temperatures for both the PCM side and the air side. The results revealed that due to the effect of convection in the PCM, for nearly 5 h of heat discharge (cool storage), the corresponding time for heat charge was only 2.5 h.

98/03319 Residual heat utilization at Voitsberg steam power plant, Austria

Tauschitz, J. *et al.* *VGB Kraftwerkstech.*, 1997, 77, (2), 98-103. (In German)

Between the electrostatic filter and the wet flue gas desulfurization unit at the title brown coal-fired power plant a tubular heat exchanger was installed to recover additional 10 MW thermal energy for district heating. In the heat exchanger, the flue gas is cooled from 150-114°C on plastic tubes. Integration and dimensioning of the exchanger and operating experiences are reported. The power plant's efficiency increased by 0.2% resulting in a brown coal saving of 1.5 t/h and in decreased CO_2 releases.

98/03320 A simplified correlation method accounting for heating and cooling loads in energy-efficient buildings

Bauer, M. and Scartezzini, J.-L. *Energy and Buildings*, 1998, 27, (2), 147-154.

Simplified correlation methods are powerful tools to compare both the energy performance of buildings and the efficiency of different HVAC control systems. For buildings in which both heating and cooling loads contribute to the energy consumption, widely used methods, like the energy signature models, are not appropriate, since they cannot simultaneously handle both heating and cooling aspects. This paper proposes a new method to overcome this difficulty. The 'Eta method' deals with internal gains, as well as solar gains, and can be used to calculate a utilization factor for free gains in the heating and cooling periods. Two examples to illustrate the method are given. The first one is a passive solar office room, on which different blind controllers were tested by simulation. The second example is a non-residential building in which two HVAC controllers were carefully monitored.